CLAIMS

1. An in-line four-cylinder engine for a vehicle including a crankshaft having crank pins of two cylinders, the crank pins provided on a common first virtual plane in arrangement with a 180° phase difference, and crank pins of the other two cylinders, the crank pins provided on a second virtual plane different by a 90° phase from the first virtual plane in arrangement with a 180° phase difference, the in-line four-cylinder engine for a vehicle comprising:

a crankshaft satisfying a formula of

$$(k_L - 0.25) \cdot (0.25 - k_R) \cong D_R / D_L,$$

wherein, when a crank web for each of at least two cylinders is divided between a pair of half crank webs faced with respect to a crank pin, k_L, k_R denote balance ratios of the both half crank webs (wherein $k_L \neq 0.25$, $k_R \neq 0.25$) and D_L, D_R denote distance from the center in a longitudinal direction of the crankshaft to the respective half crank webs, the crankshaft being arranged that crank webs for four cylinders be set so that a track of a vector of a primary inertial couple would be formed into a substantially circular shape; and

a primary balancer for generating a couple vector offsetting a vector of the first inertia couple.

2. The in-line four-cylinder engine for a vehicle according to Claim 1, wherein $(k_L + k_R)$ for at least a part of the cylinders is less than 0.5.

3. The in-line four-cylinder engine for a vehicle according to Claim 1, wherein (k_L + k_R) for at least a part of the cylinders is more than 0.5.

4. The in-line four-cylinder engine for a vehicle according to Claim 1, wherein two cylinders satisfy a condition in Claim 1 and both of the balance ratios k_L and k_R of the other two cylinders are set at 0.25.

5. The in-line four-cylinder engine for a vehicle according to any one of Claims 1 to 3, wherein the crankshaft has crank pins of the first and fourth cylinders, the crank pins being located on the first virtual plane, and crank pins of the second and third cylinders, the crank pins being located on the second virtual plane, when the first to fourth cylinders are provided in this order from an end.

6. The in-line four-cylinder engine for a vehicle according to Claim 1, wherein the crankshaft has crank pins of the first and third cylinders, the crank pins being located on the first virtual plane, and crank pins of the second and fourth cylinders, the crank pins being located on the second virtual plane.

7. The in-line four-cylinder engine for a vehicle according to Claim 1, wherein the crankshaft has crank pins of the first and second cylinders, the crank pins being located on the first virtual plane, and crank pins of the third and fourth cylinders, the crank pins being located on the second

virtual plane.

8. The in-line four-cylinder engine for a vehicle according to Claim 5, wherein balance ratios k_L and k_R and distance D_L and D_R of half crank webs of the respective cylinders are symmetrical between the first and fourth cylinders and symmetrical between the second and third cylinders.

9. The in-line four-cylinder engine for a vehicle according to Claim 6 or 7, wherein the distance D_L and D_R is symmetrical between the first and fourth cylinders and between the second and third cylinders while the balance ratios k_L and k_R of half crank webs are symmetrical between arbitrary combined two cylinders.

10. The in-line four-cylinder engine in Claim 1, wherein the primary balancer is provided parallel to the crankshaft, balance weight is provided at a location opposite to the crank pins of the second and third cylinders or a location opposite to the crank pins of the first and fourth cylinders.

11. A vehicle provided with the in-line four-cylinder engine for a vehicle according to Claim 1.